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### **REMARKS**

Entry of this Amendment is proper because it narrows the issues on appeal and does not require further search by the Examiner.

Claims 8, 15, 23-32, and 34-39 are all the claims presently pending in the application. Claims 8, 15, 23, 26 and 37 have been amended to more particularly define the invention. Claims 33 and 40 have been canceled.

It is noted that the claim amendments are made only for more particularly pointing out the invention, and not for distinguishing the invention over the prior art, narrowing the claims or for any statutory requirements of patentability. Further, Applicant specifically states that no amendment to any claim herein should be construed as a disclaimer of any interest in or right to an equivalent of any element or feature of the amended claim.

Claims 8, 15, 24-32, 34-35 and 40 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zheng, et al. (U.S. Patent No. 5,728,621), in view of Liao (U.S. Patent No. 6,110,795), and Kunikiyo (U.S. Patent No. 6,620,703). Claims 23, 33 and 36-39 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Zheng, in view of Liao, and Kunikiyo, in further view of Wolf (Silicon Processing for the VLSI ERA, Vol. 2, Lattice Press, 1990, pages 48, 58, 522-523).

These rejections are respectfully traversed in the following discussion.

#### **I. THE CLAIMED INVENTION**

The claimed invention (e.g., as recited in claim 1) is directed to a semiconductor substrate having a trench region comprising at least one trench, the trench comprising a single layer of high-density plasma (HDP) oxide having an unpolished upper surface, and a non-trench region having an upper surface which is substantially co-planar with the unpolished upper surface of the single layer of the HDP oxide, the upper surface of the non-trench region including implanted dopants. Importantly, a thickness of the single layer of HDP oxide includes an as-deposited thickness.

Conventional substrates having shallow trench isolation (STI) regions require harsh

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etching or chemical mechanical polishing (CMP) to planarize the surface of the substrate and filler material formed in trenches in the substrate. As a result the surface of the trench fill material includes scratches and chatter marks.

The claimed substrate, on the other hand, includes a single layer of HDP oxide having a thickness which includes an as-deposited thickness (Application at page 7, lines 4-5; Figure 3). That is, in addition to the HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, the HDP oxide layer also has a thickness that is the same as the deposited thickness. This allows the HDP oxide to be planarized with the non-trench region without requiring an etching or chemical mechanical polishing (CMP). Therefore, the HDP oxide may provide a low dielectric constant trench fill which does not necessarily include scratches and chatter marks (Application at page 12, line 13-page 13, line 3).

## II. THE PRIOR ART REFERENCES

### A. The Zheng, Liao and Kunikiyo References

The Examiner alleges that Zheng would have been combined with Liao, and that the alleged Zheng/Liao combination would have been further combined with the Kunikiyo reference to form the claimed invention of claims 8, 15, 24-25, 27, 29-32 and 34-35. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention.

Zheng discloses a method for forming planarized oxide shallow trench isolation. In the Zheng method, a high density plasma (HDP) oxide layer is deposited in the isolation trenches. A layer of spin-on-glass is coated over the HDP oxide layer. The spin-on-glass layer and portions of the HDP oxide layer remaining are polished away so that the substrate is planarized (Zheng at Abstract).

Liao discloses a method of correcting the scratches caused by CMP. In the Liao method, a microscratch formed in an isolation trench caused by chemical mechanical polishing is corrected by forming a sacrificial layer on the damaged trench fill so that the micro-scratch is thus filled with the sacrificial layer. Using a hard mask as an etch stop, the sacrificial layer is

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etched back. Since the etching rate of the sacrificial layer is the same as or lower than the isolation trench material, the formation of the micro-scratch is suppressed during the etching back process (Liao at Abstract).

Kunikiyo discloses a device having isolation characteristics of an isolation trench which are allegedly enhanced. In the device, elements to be isolated by an isolation trench (STI 2) are formed in active semiconductor regions shown by arrows 30 and 31 on a semiconductor substrate 1. The STI 2 is filled with SiOF (Kunikiyo at Abstract; Figure 1).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, these references are directed to different problems. Specifically, Zheng planarizes a substrate surface by chemical mechanical polishing (CMP), whereas Liao teaches a method of correcting the damage (e.g., microscratches) caused by CMP (Liao at col. 1, lines 13-17). Indeed, Zheng does not even recognize the surface damage (e.g., scratches, chatter marks) caused by CMP and, unlike Liao, does not take any action to correct the damage. Therefore, Liao specifically teaches that the Zheng device is defective. Clearly, these references teach away from each other so that no person of ordinary skill in the art would have considered combining the references.

In addition, Kunikiyo is intended to improve the isolation characteristics of a isolation trench by using SiOF as a filler material. Clearly, this is unrelated to Zheng and Liao which are directed to planarizing methods. Thus, no person of ordinary skill in the art would have considered combining an alleged Zheng/Liao combination with the Kunikiyo reference.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination as alleged by the Examiner. Indeed, the Examiner supports the combination by merely stating that it would have been obvious "to modify Zheng by choosing a removal method taught by that will result in a substantially scratch free surface as taught by Liao with reasonable expectation of producing a trench fill with a planar surface with reduced surface flaws" and that Kunikiyo would have been combined with an alleged Zheng/Liao combination "to improve upon the mismatch in volumetric expansion between the fill and silicon substrate". However, the references do not include such a suggestion as alleged by the Examiner.

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Therefore, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, contrary to the Examiner's allegations, neither Zheng nor Liao, nor Kunikiyo, nor any combination thereof, teaches or suggests "*wherein a thickness of said single layer of HDP oxide comprises an as-deposited thickness*" as recited, for example, in claims 8, 15 and 23.

As noted above, conventional substrates having shallow trench isolation (STI) regions require harsh etching or chemical mechanical polishing (CMP) to planarize the surface of the substrate and filler material formed in trenches in the substrate (Application at page 2, lines 9-18). As a result the surface of the trench fill material includes scratches and chatter marks.

The claimed substrate, on the other hand, includes a single layer of HDP oxide having a thickness which includes an as-deposited thickness (Application at page 7, lines 4-5; Figure 3). That is, in addition to the HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, the HDP oxide layer also may include a thickness that is the same as the deposited thickness. This allows the HDP oxide to be planarized with the non-trench region without requiring an etching or chemical mechanical polishing (CMP). Therefore, the HDP oxide may provide a low dielectric constant trench fill which does not necessarily include scratches and chatter marks (Application at page 12, line 13-page 13, line 3).

Clearly, the cited references do not teach or suggest these novel features. Indeed, Kunikiyo teaches that the SiOF film 40 is "flattened" by CMP (Kunikiyo at Figure 4; col. 11, lines 55-59). Further, Liao teaches that the isolation layer 30 is planarized using CMP (Liao at col. 2, lines 56-60). Indeed, the purpose of Liao is to address scratches formed by CMP. Moreover, the Examiner has not alleged that these reference teach or suggest an HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, and having a thickness that is the same as the deposited thickness.

Likewise, Zheng does not teach or suggest these novel features. The Examiner alleges that "Zheng fills the trench with deposited material, thus the thickness of the deposited material is 'as deposited thickness'". Applicant notes that at one point in the fabrication of the Zheng

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device, the trench filler in Zheng may be deposited. For example, Figure 3 illustrates a filler material 18 which is deposited on the substrate.

However, Zheng teaches that the filler material 18 is planarized by polishing (Zheng at Abstract; col. 3, lines 21-25). The Examiner alleges that Zheng teaches that the filler material 18 may be "optionally polished". Applicant notes that Zheng may disclose that the trench fill is optionally polished. However, Zheng clearly teaches that the result of not polishing the structure is a filler material 18 which is not planarized with the surface of the substrate 10. This is clearly shown in Figure 5 of Zheng. That is, Zheng teaches only one way to achieve a planarized structure (e.g., as illustrated in Figure 6) and that is to perform CMP.

Moreover, Applicant respectfully submits that even assuming that the Examiner is correct (which he is not) that Zheng teaches that the structure may be planarized by etching, the Examiner has conceded that Zheng would still require some subtraction of the thickness of the filler material 18 in order planarize the filler material 18. That is, even assuming that the Examiner is correct (which he is not), nowhere does Zheng teach or suggest an HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, and having a thickness that is the same as the deposited thickness.

Therefore, unlike the claimed invention, in which the HDP oxide has an as-deposited thickness and is co-planar with the non-trench region, Zheng teaches a device in which the filler material 18 must be worked (e.g., by CMP) to be planarized, which one of ordinary skill in the art knows, will damage the filler material to some extent. Therefore, the Zheng device is clearly inferior to the claimed invention.

Therefore, none of the cited references, nor any combination thereof, teaches or suggests an HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, and having a thickness that is the same as the deposited thickness.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

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### **B. The Wolf Reference**

The Examiner alleges that Wolf would have been combined with an alleged Zheng/Liao/Kunikiyo combination to form the claimed invention of claims 23, 33 and 36-39. Applicant submits, however, that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed method OR invention.

Wolf discloses a silicon substrate which is implanted with boron ions (Wolf at Figure 22-32(a)).

However, Applicant submits that these references would not have been combined as alleged by the Examiner. Indeed, Wolf is merely directed to a silicon processing method which includes boron-doping. This is completely unrelated to Zheng and Liao which are directed to planarizing isolation regions, and Kunikiyo which is intended to improve the isolation characteristics of a isolation trench by using SiOF as a filler material. Clearly, these references are unrelated and no person of ordinary skill in the art would have considered combining the references.

Further, Applicant submits that the Examiner can point to no motivation or suggestion in the references to urge the combination. Indeed, Applicant respectfully submits that one of ordinary skill in the art would not have been so motivated to combine the references as alleged by the Examiner. Therefore, the Examiner has failed to make a prima facie case of obviousness.

Moreover, contrary to the Examiner's allegations, neither Wolf, nor Zheng nor Liao, nor Kunikiyo, nor any combination thereof, teaches or suggests "*wherein a thickness of said single layer of HDP oxide comprises an as-deposited thickness*" as recited, for example, in claims 8, 15 and 23.

As noted above, unlike conventional substrates, the claimed substrate includes a single layer of HDP oxide having a thickness which includes an as-deposited thickness (Application at page 7, lines 4-5; Figure 3). That is, in addition to the HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, the HDP oxide layer also may include a thickness that is the same as the deposited thickness. This allows the HDP oxide to be

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planarized with the non-trench region without requiring an etching or chemical mechanical polishing (CMP). Therefore, the HDP oxide may provide a low dielectric constant trench fill which does not necessarily include scratches and chatter marks (Application at page 12, line 13- page 13, line 3).

Clearly, the cited references do not teach or suggest these novel features. Indeed, as noted above, Wolf merely teaches boron-doping of a silicon substrate. This is completely unrelated to the claimed invention. That is, nowhere does Wolf teach or suggest an HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, and having a thickness that is the same as the deposited thickness.

In fact, Applicant would point out that the Examiner is not relying on Wolf as teaching or suggesting these novel features. That is, the Examiner has not alleged that Wolf teaches or suggests an HDP oxide layer having a surface which is substantially co-planar with a surface of the non-trench region, and having a thickness that is the same as the deposited thickness.

Therefore, Wolf clearly does not make up for the deficiencies of the other cited references.

Therefore, Applicant submits that these references would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. Therefore, the Examiner is respectfully requested to withdraw this rejection.

### III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 8, 15, 23-32, and 34-39, all the claims presently pending in the application, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any

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overpayment in fees to Assignee's Deposit Account No. 09-0456.

Respectfully Submitted,

Date: 3/16/04



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**CERTIFICATE OF FACSIMILE TRANSMISSION**

I hereby certify that the foregoing Amendment was filed by facsimile with the United States Patent and Trademark Office, Examiner David Blum, Group Art Unit # 2813 at fax number (703) 872-9306 this 16<sup>th</sup> day of March, 2004.



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